

Synoptic Analysis: Tuesday 20 September 2016

- A large-scale trough remains stationary over Greenland and Iceland, with an associated stationary mature surface cyclone centred southwest of Iceland.
- Continuing confluence of warm subtropical and cold polar air masses has strengthened the frontal zone that extends now from Newfoundland to Iceland and further poleward to Svalbard.
- A frontal wave developed at the frontal zone (55N, 20W) and features incipient strong WCB activity, with ascending air along the leading edge of the upper-level trough.

Forecast Day 1 Wednesday 21 September 2016: planned mission

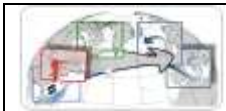
- The frontal wave strongly intensifies between 20 and 21 September while moving towards the south of Iceland.
- In the afternoon WCB outflow is located directly over Iceland, ascent just to the South of Iceland, maybe even some inflow to the Southeast of Iceland.
- Diabatic WCB outflow erodes the trough over Iceland and forms a marked tropopause step just to the Northwest of Iceland.
- Model consistency: Outflow height varies with different forecast initialisation times (BT), with the latest forecasts consistently predicting PV erosion up to 315K and strongest negative PV advection by irrotational wind at 315K. Region of PV erosion is consistently predicted over Iceland. Position of surface cyclone, warm sector, and WCB ascent region continuously predicted closer to Iceland in BT 18/12Z to BT 20/00Z. BT20/12Z again features a slightly more southward position of the cyclone centre. Still the impact of this shift on the upper-level PV erosion and ridgebuilding is marginal.

Forecast Day 2-3 Thursday 22, Friday 23 September 2016

- The former frontal wave becomes a mature quasi-stationary cyclone with its centre over and slightly south of Iceland on Thursday, 22 September.
- Over the Atlantic ongoing advection of warm-subtropical air feeds into another incipient cyclogenesis north of Newfoundland (52N, 50W). This cyclone propagates along the persistent baroclinic zone towards Iceland and strongly intensifies on Friday before reaching Iceland.
- Along with the cyclone, a strong WCB forms in the eastern North Atlantic with a pronounced inflow and ascent region west of the British Isles and Ireland, and later just to the Southeast of Iceland. WCB outflow is more anticyclonic into central Norway.
- Model consistency: The cyclogenesis of the Friday cyclone is consistent for BT 18/12Z to 20/12Z, the inflow and ascent region of the WCB shift only marginally. However, the WCB outflow region remains uncertain, with latest forecast initialisation times favouring a more anticyclone WCB outflow branch.

Forecast Outlook

- On Saturday and Sunday 24-25 September the Friday cyclone becomes again stationary South of and over Iceland replacing the former Wednesday cyclone. In the wake of the cyclone strong



atmospheric river type moisture transport occurs, and impinges on the British Isles and Northern Europe, with the potential for heavy precipitation and strong winds.

- In the subtropical Atlantic (30N, 58W) tropical storm Karl intensifies initially as a tropical system and starts propagating into the midlatitudes. At the same time another Newfoundland cyclone forms (“downstream cyclone”) and interacts with moisture of sub-tropical origin that is transported poleward downstream of TC Karl. The subsequent evolution is very uncertain, with either and/or both of the systems having the potential to strongly deepen and to reach Iceland during Tuesday-Thursday 27-29 September. Both systems are embedded in a strong atmospheric river, that might cause again heavy precipitation in Europe later next week.
- Very strong WCB activity is associated with Ex-TC Karl and the “downstream cyclone”. Although the individual evolution of these systems is not clear, yet, strong ridgebuilding is consistently predicted South of Iceland, reaching high isentropic levels (340K).
- Along with this evolution very strong negative PV advection at upperlevels strongly enhance the tropopause PV gradient. This is most likely due to very intense diabatic outflow of ascending air in the region where tropical and polar air masses merge at lower levels. Consequently an extremely intense zonally-aligned upper-level jet stream evolves over the North Atlantic with maximum wind speeds potentially exceeding 90 m s^{-1} at 300hPa.

Scientific discussion

- New planning tool: Forward trajectories from curtain below flight track. (Heini Wernli).
- Flight Wednesday 21. September:
 - Jim Doyle: Strong sensitivities in COAMPS moist adjoint model for Wednesday cyclones, at 850hPa in cyclone area, at 250hPa at tropopause region. HALO and Falcon will sample these regions.
 - Do both Halo and Falcon missions, even if the forecast shifts.
- Flights Friday/Saturday 23/24 September:
 - Details of the HALO flight on Friday. Aim to capture WCB (inflow) ascent west of Ireland below the NAT tracks. HALO flight already very long, use Falcon to measure outflow? Cloud cover problematic, so that we might only have cloud radar, and drop sondes into ascent region. Optimal flight level for HALO?
 - We might not be able to start next HALO early enough on Saturday in order to measure WCB outflow in a truly Lagrangian sense (recapture air, observed on Friday). Falcon mission to measure WCB outflow close to Iceland in the night from Friday to Saturday and HALO later on Saturday to Norway to catch WCB outflow, or skip Saturday flight because of a more promising situation on Monday?
 - How to coordinate location and timing with FAAM aircraft (measurement of microphysical cloud properties at low-levels)?